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2D Modelling single sheet tester

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Abstract*:* In this study a Single Sheet tester is simulated using a 2D Finite elements methods by Matlab. Its main goal is to find the best geometrical structure. The simulations have been performed using the magnetic vector potential A formulation and have been limited to a magnetostatic case. The influence of the geometrical parameters and there magnetic properties are taken account in order to optimise the conception of the device.

Keywords: Single Sheet tester SST, finite elements, H coils methods, Power loss.

I. INTRODUCTION

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The magnetic sheets are used so increasingly intensive especially with the development of electromechanical devices. Applications of magnetic materials are extremely broad, since it allows the transmission and use of electrical energy. Soft ferromagnetic materials are the main components of the magnetic circuits of electrical devices, Standardized determination of magnetic properties of soft magnetic materials mainly FeSi is obtained for a sinusoidal magnetic induction is unidirectional. There are two systems of characterization, the first uses the Epstein frame is built around the second part of the single band (Single Sheet Tester SST). This work shows the process that was followed for the experimental realization of the SST framework for the characterization of samples with dimensions as 500*500 mm^2 at Electromagnetic Systems Laboratory of the EMP.

The choice of sample size results in fact the general design of the system and this in on the recommendation of (IEC), which requires a sample , these dimensions are best suited to the development of magnetic materials. For a better understanding of the problem of standardized measure was diagrammed in Figure 1 the different techniques of measurement of magnetic losses, these measures are based on physical concepts and consistent experimental approach.

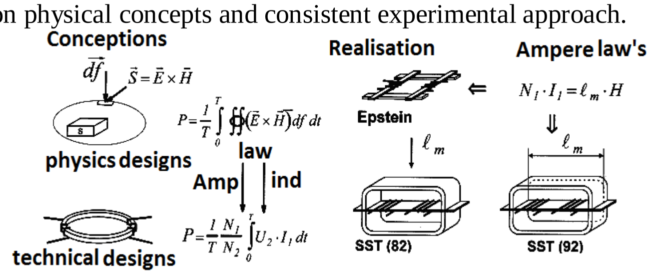

Fig.1. Devices for the determination of magnetic losses [1].

The Epstein method requires that the sample is cut into the shape of strips, the mandatory multiple of 4 standard dimensions are then trimmed, weighed and annealed according to specific standards. These strips are then stacked in solenoids so as to form seals in the double overlap angles. These operations involve a long and tedious manipulation. To overcome the problems associated with the use of the standard framework Epstein wants it to be replaced by the SST frame, it uses a single sample, the stream is closed by two highly permeable symmetrical yokes (U-shaped).

II. MODELING

To better design the structure of the "frame single band" and highlight the importance of different parameters (geometrical and physical) associated with it we carried out a numerical modeling using matlab software. This allows solving partial differential equations of electromagnetism on complex geometries taking into account the laws of material behavior.

For the two dimensional analysis, the geometric structure of the system was reduced at a transverse cut. Indeed, the 2D modeling assumes a dimension which we denote Z is very large compared to the other (x and y), the currents are parallel to this direction and vector fields H and induction B are perpendicular. Under these conditions there is a section examines the problem and the leakage flux is neglected along the Z axis

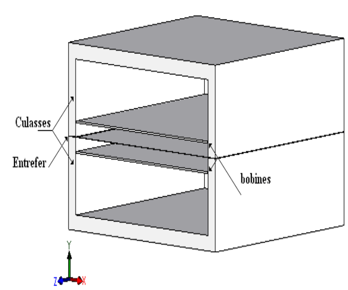

Fig.2. SST frame geometry.

The problem is vector, therefore projected onto the three axes, our study is limited in two dimensions which implies that the components of the vector potential and current are perpendicular to study'"' XY plane. Magnetostatic problem becomes [2], [3], [4]:

$$\frac{\partial}{\partial x}\left(\frac{1}{\mu}\frac{\partial A_z}{\partial x}\right)+\frac{\partial}{\partial y}\left(\frac{1}{\mu}\frac{\partial A_z}{\partial y}\right)=J_z \qquad (1)$$

J : Density of the electric current.

A_z : Magnetic vector potential.

μ : Magnetic Permeability.

Characteristic of environments:

-Cylinder head material: material type FeSi grain oriented thicknesses 0.3mm, section 25*500 mm^2, 25000 permeability and maximum induction is de1.5T.

-Sample: materials FeSi type grain oriented 0.3 mm thickness, permeability and 8400 the maximum induction of 1.7T.

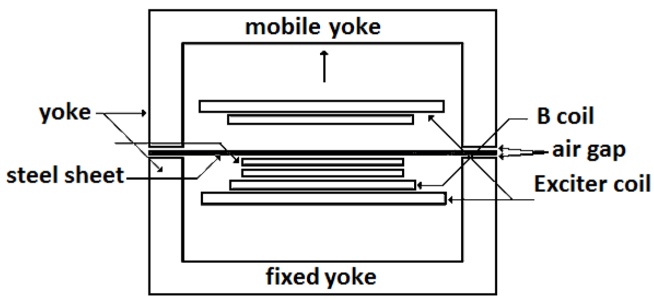

Fig.3. Setting the frame single band SST

III. INFLUENCE OF MAGNETIC HEAD BAND SINGLE FRAME

A. Influence thickness of the yoke

To study the influence of the width of the yoke we set various parameters of the frame (excitation, permeability, thickness of the sample, the length of the frame ... etc.).

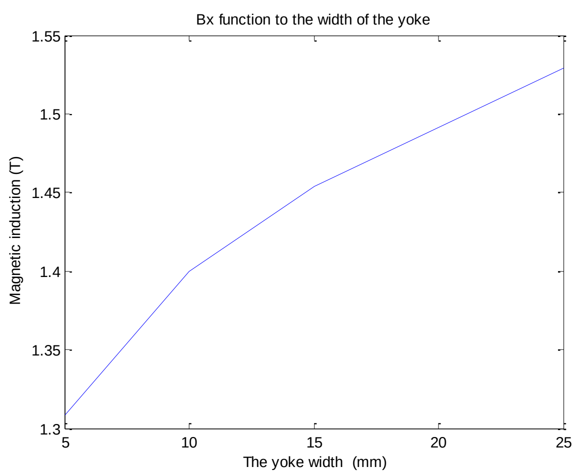

Fig.4. Influence of the width of the yoke of the induction along the x axis.

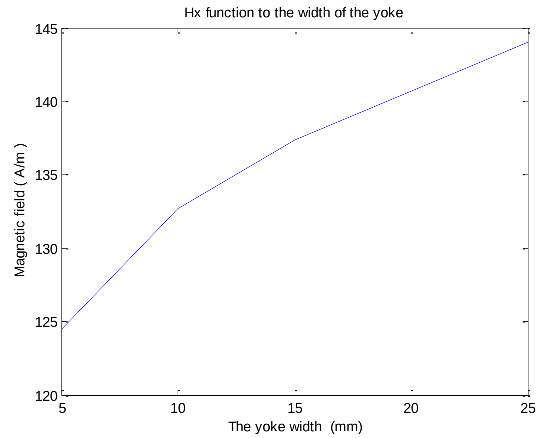

Fig.5. Influence of the width of the yoke of the magnetic field on the x axis.

These figures Fig.3, Fig.4, show that an increase of the thickness of the yoke 5 to 25 mm causes a gain in the order of induction of 17.8 %.

B. Influence the head height

The same approach was extrapolated to optimize the height of the yoke there is in fact a decrease in the induction of about 0.8% (Fig. 5).

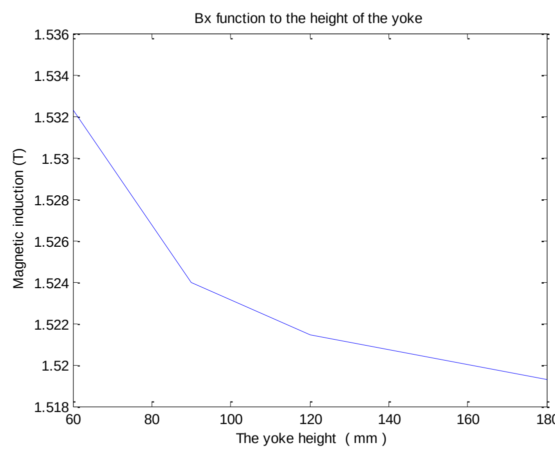

Fig.6. Influence of the head height of the induction along the x axis.

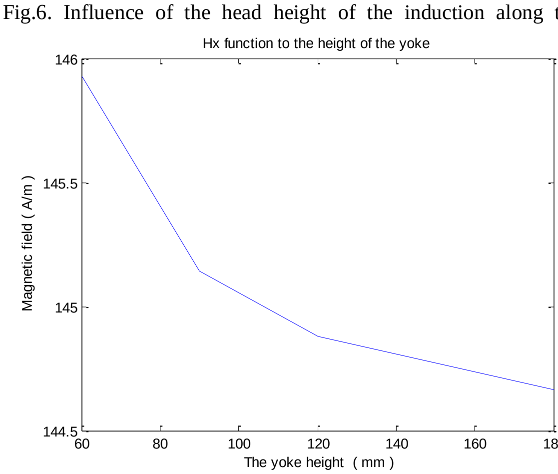

Fig.7. Influence of head height on the x axis magnetic field.

When the height of the head decreases the magnetic flux passing through the sample increases, but it is not necessary that this height is too small because it will corrupt the measurements by the method of the coil tangentially, the latter principle is based on the conservation of the tangential component of the magnetic field.

C. INFLUENCE OF MAGNETIC PERMEABILITY OF THE HEAD

To determine the influence of the magnetic permeability of the yoke on the flow through the sample, we changed the value of the latter and we traced the following lines:

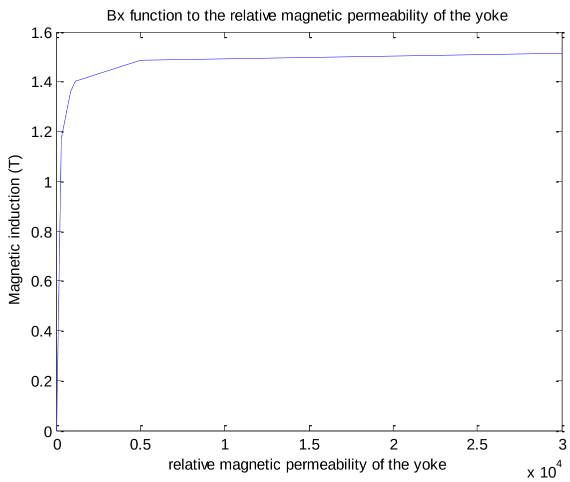

Fig.8 . Influence of the permeability of the magnetic yoke on the induction along the x axis .

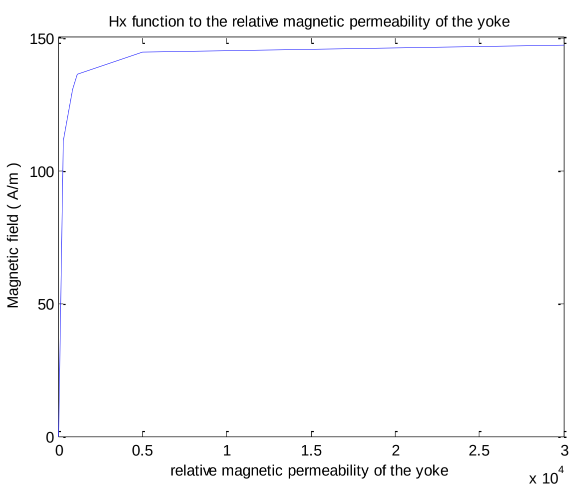

Fig.9 . Influence of the permeability of the yoke on the magnetic field along the x axis .

To minimize the leakage flux , the yokes must be highly permeable to the maximum flow channel in the sample. The above figures show that, for a relative permeability less than 1000 a low inductance is obtained , this implies a presence of a high leakage flux .
When the permeability increases the flow is channeled in the magnetic circuit . And these results are in accordance with IEC requirements [5], [6] wanting cylinder heads that is more permeable to using this kind of laminations FeSi or FeNi GNO .

IV. CONCLUSION

SST frame vertical two yokes type provides a better homogeneity of the magnetic field. We modeled this context , examining all the parameters that affect the quality of our realizable IEC defines the overall dimensions of the frame, these rules , and these requirements are not clear , for example the height of the head varies 90 to 150 cm , the materials used may be FeSi or FeNi GO . We therefore studied the different parameters to optimize the choice of the best frame geometry SST.

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